

APPENDIX M
MONITORING & ADAPTIVE MANAGEMENT PLAN

*Feasibility Report with Integrated Environmental Assessment
Rip Rap Landing HREP*

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RIP RAP LANDING MONITORING AND ADAPTIVE MANAGEMENT PLAN

INTRODUCTION

The 1985 Supplemental Appropriations Act (Public Law 99-88) and Section 1103 of the Water Resources Development Act of 1986 (Public Law 99-662) authorized implementation of ecosystem restoration projects to ensure the coordinated development and enhancement of the Upper Mississippi River system (UMRS). WRDA 2007, Section 2039 details requirements for monitoring and adaptive management for ecosystem restoration project performance.

At the programmatic level, knowledge gained from monitoring one project can be applied to other projects. Opportunities for this type of adaptive management are common within the Upper Mississippi River Restoration (UMRR) program. Using an adaptive management approach during project planning enabled better selection of appropriate design and operating scenarios to meet the Rip Rap Landing HREP project objectives. Lessons learned in designing, constructing, and operating similar restoration projects within the UMRS have been incorporated into the planning and design of this HREP to ensure that the proposed plan represents the most effective design and operation to achieve the project goal and objectives.

The adaptive management plan for the Rip Rap Landing HREP describes and justifies whether adaptive management is needed in relation to the proposed project management alternatives identified in the project feasibility study. This appendix outlines how the results of the project-specific monitoring plan would be used to adaptively manage the project, including monitoring targets which demonstrate project success in meeting project objectives. The District's intent was to develop monitoring and adaptive management actions appropriate for the project's goal and objectives.

Adaptive management provides a process for making decisions in the face of uncertainty. The primary incentive for implementing an adaptive management plan is to increase the likelihood of achieving desired project outcomes given the identified uncertainties, which can include incomplete description and understanding of relevant ecosystem structure and function; imprecise relationships among project management actions and corresponding outcomes; engineering challenges in implementing project alternatives; and ambiguous management and decision-making processes. Additional uncertainties (i.e., scientific and technological) relating to the proposed project were identified by the project team which included:

- Mississippi River hydrology
- Presence and introduction of invasive species
- Future climate change projections (e.g., flood events, growing season lengths, ice cover, migration patterns)

GOALS and OBJECTIVES

The primary goal of the RRL HREP is to increase quantity and quality of aquatic, non-forested wetland, and forested wetland habitats in the project area. The goal will be achieved through the following objectives:

- (1) Improve aquatic ecosystem resources;

- (2) Increase native plant species diversity and reduce number of acres impacted by invasive plant species by improving water level management;
- (3) Reduce impacts of headwater flooding and river-borne sedimentation; and,
- (4) Increase quantity and quality of bottomland hardwood forest.

PERFORMANCE INDICATORS

Performance indicators to the above objectives were developed with the best available knowledge. They were developed to be specific, measureable, attainable, realistic, and timely. Current performance indicators are summarized in Table 1. The conceptual monitoring schedule and estimated costs are provided in Table 2.

Each project objective was assessed by at least one performance indicator. For each performance indicator, the rationale behind the indicator and the methodology used are discussed. In addition, the monitoring targets (also referred to as desired outcomes) and action criteria (also referred to as adaptive management triggers) are listed. The action criteria are used to determine if and when adaptive management actions should be implemented.

Objective 1: Improve aquatic ecosystem resources

Performance Indicator 1A: Roadside Lake connected to Mississippi River via Sny Creek

Rationale: Currently, the Old Sny Creek channel lacks year-round connectivity to the Mississippi River, which in turn, isolates Roadside Lake, a floodplain lake, from the river. Project features are designed to improve depth within Sny Creek providing year-round aquatic connectivity between the Mississippi River and Roadside Lake. This year-round connectivity will provide aquatic species access to important spawning and rearing habitat.

Methodology: Duration and frequency of connectivity between Roadside Lake and the Mississippi River via Sny Creek will be recorded by site staff to determine how many days these areas are connected.

Monitoring Targets (Desired Outcomes): With the improved depth within Sny Creek, Roadside Lake should have year-round connectivity with the Mississippi River. Results should be realized in the first year after construction completion.

Action Criteria (Adaptive Management triggers): Overtime it is likely that Sny Creek will lose depth and re-excavation will be needed to maintain year-round connectivity. If connectivity falls below 50% of the year for 3 consecutive years (since part of this indicator is dependent on river hydrology) then the project team and project sponsor would re-evaluate the need to re-excavate to maintain connectivity. It is estimated by year 30 this would need to occur, and the cost of re-excavation has been incorporated into the annual OMRR&R costs for the project.

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Table 1. Project objectives, indicators, and time before the effects become apparent at RRL.

| Project-Wide Goal | Site-Specific Objective | Performance Indicator | Monitoring Target | Action Criteria (AM triggers) | Time of Effect | Responsible Party ^{1,2} |
|---------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|---------------------------|----------------------------------|
| Increase quantity and quality of aquatic, non-forested, and forested wetland habitats | Improve aquatic ecosystem resources | Roadside Lake connected to Sny Creek | 365 days per year | Connectivity <50% of year for 3 consecutive years | Construction Completion | IDNR |
| | Increase native plant species diversity and reduce number of acres impacted by invasive plant species by improving water level management | Water delivery and drainage | Ability to drain or flood zones 3 and 4 in ≤ 10 days | Further identified during plans and specifications | Construction Completion | IDNR |
| | | Species composition & quality of annual and perennial herbaceous vegetation (relative cover and frequency) | Diversity threshold = 30:70 ratio of annuals and perennials Species richness threshold = ≥ 8 species per management area Quality threshold = importance value score of ≥ 3.5 % invasive species = maintain below 5% relative cover and frequency per management area | Apply adaptive management actions if any of the monitoring targets fall outside the desired thresholds | 4 year post construction | IDNR/ USACE |
| | Reduce impacts of headwater flooding and river-borne sedimentation | Site experiences only back flooding | 4 out of 5 years | Further identified during plans and specifications | Construction completion | IDNR |
| | Increase quantity and quality of bottomland hardwood forest | Survival of planted trees | 80% survival of trees | <50% survivability | 5 years post construction | IDNR/ USACE |

¹IDNR will submit reports of data collection at years 1 and 5-10 to the MVS LTRM manager.

²Individual agencies will be responsible for providing their share of funding for the monitoring.

Table 2. RRL Conceptual Monitoring Plan. Construction is set at Year 0.

| INDICATOR | -1 | 0 | +1 | +2 | +3 | +4 | +5 | +6 | +7 | +8 | +9 | +10 |
|---------------------|----------|--------------|------|----|----|----|------|------|------|------|------|------|
| Connectivity* | | Construction | X | X | X | X | X | X | X | X | X | X |
| Water | X | | X | | | | | | | | | |
| Vegetation | | | | | | | X | X | X | X | X | X |
| Headwater* | | | X | X | X | X | X | X | X | X | X | X |
| Trees | | | X | | | | X | | | | | X |
| Estimated Cost (\$) | 2000 | | 2500 | | | | 3000 | 2000 | 2000 | 2000 | 2000 | 5000 |
| SUBTOTAL | \$20,500 | | | | | | | | | | | |
| Contingency (25%) | \$5,125 | | | | | | | | | | | |
| TOTAL | \$26,000 | | | | | | | | | | | |
| Average Annual Cost | \$700 | | | | | | | | | | | |

* No additional monitoring costs would be required since these observations are part of normal site management

Objective 2: Increase native plant species diversity and reduce number of acres impacted by invasive plants species by improving water level management

Performance Indicator 2A: Water delivery and drainage

Rationale: Currently, the water level management at RRL is operating at an inadequate water conveyance capacity. The existing system prevents optimum water drainage and delivery within the project area, limiting the ability to provide needed wetland habitat for a variety of migratory and resident wildlife. Additionally, with inadequate water conveyance, reed canary grass, an invasive plant species is becoming dominant within the project area. Project features are designed to improve water delivery and drainage.

Methodology: Pre- and post-construction dewatering and filling times will be recorded by site staff to determine the change in water drainage and delivery efficiencies.

Monitoring Target (Desired Outcome): With the improved water delivery and drainage capacity, Zones 3 and 4 should be able to reach target water levels within 10 days. Results should be realized in the first year after construction.

Action Criteria (Adaptive Management Trigger): The estimated target water level for Zones 3 and 4 is 441.0 AMSL. However, more specific decision criteria may be developed during the pre-construction engineering and design phase of the project since additional data may become available to further refine the target water levels. Water level management is a primary tool used by IDNR to generate the desired vegetative response. Vegetation monitoring would be the principal driver in determining what water level management the IDNR would implement for any given year.

Performance Indicator 2B: Species composition and quality of annual and perennial herbaceous vegetation

Rationale: Managing water levels to promote a diverse suite of annual moist soil plants provide migratory and resident wildlife with nutritional resources (e.g., seeds and tubers) that are needed to complete vital annual life stages. Project features are designed to improve water level manipulation which will directly improve the ability to manage for moist soil plants contingent on the reduction of reed canary grass in the project area. The use of plant species composition is a tool commonly used to evaluate moist soil wetland habitat.

Methodology: The design and methodology for monitoring wetland plant species will follow the approved protocol outlined in the “Upper Mississippi River Restoration Monitoring Program Design Handbook Section 1: Vegetation” (McCain 2014¹). Pre-construction and post-construction data will be collected by site staff and/or USACE.

Monitoring Target (Desired Outcome): The targets for species composition and quality include the following:

- Diversity Threshold = A ratio of 30:70 annuals to perennials per management area
- Species Richness Threshold = Greater than 8 species per management area
- Quality Threshold = Combined importance value of top 4 dominant species greater than or equal to 3.5
- Percent Invasive Species below 5% relative cover and frequency per management area

Action Criteria (Adaptive Management Trigger): Adaptive management actions should be implemented if any of the below action criteria are triggered. Adaptive management could include, but not limited to, physical disturbance (e.g., mowing, disking, rolling, prescribed fire), chemical control, or drawdown. The exact management action implemented will be decided by the site manager.

- Diversity Threshold outside the desired 30:70 annuals to perennials ratio
- Species Richness Threshold < 8 species per management area
- Quality Threshold: combined importance value of top 4 dominant species less than 3.5
- Percent invasive species above 5%

Objective 3: Reduce impacts of headwater flooding and river-borne sedimentation

Performance Indicator 3A: Site experiences only back flooding

Rationale: Currently, the project area experiences headwater flooding which scours and deposits river-borne sediments into the wetlands, reducing their quality. Project features are designed to reduce headwater flooding and in turn reduce river-borne sedimentation.

Methodology: Upon completion, each year site staff will record how many times, if any, the filled scour areas experience headwater flooding.

Monitoring Target (Desired Outcome): The known areas of scour will be filled thus reducing headwater flooding. The target for the area is to experience back flooding rather than headwater flooding at least 4 out of 5 years. Results should be realized after construction completion.

¹ McCain, K.N.S., editor. 2014. *Upper Mississippi River Restoration Environmental Management Program Monitoring Design Handbook Section 1: Vegetation*. U.S. Army Corps of Engineers, Rock Island, Illinois.

Action Criteria (Adaptive Management Trigger): No adaptive management trigger identified at this time since this indicator is dependent on river hydrology. During plans and specification the action criteria may be further refined.

Objective 4: Increase quantity and quality of bottomland hardwood forest

Performance Indicator 4A: Survival and growth of planted trees

Rationale: Bottomland hardwoods have been reduced within the project area due to historic clearing for agriculture and impacts of flood events. Project features to plant trees on former agricultural fields, which are on relatively higher ground reducing negative flood impacts, would increase the quantity and quality of bottomland hardwoods within RRL.

Methodology: The design and methodology for monitoring forested wetlands will follow the approved protocol outlined in the “Upper Mississippi River Restoration Monitoring Program Design Handbook Section 1: Vegetation” (McCain 2014). Success of planted trees will be monitored 1- and 5-year post-planting to determine % survivorship (tree count). In addition based on Henderson et al (2009)² relative growth rate (RGR) will also be calculated to determine success/survivorship (where $RGR > 0$ equals positive level of production and survivorship; while $RGR < 0$ equals loss of production and mortality).

Monitoring Target (Desired Outcome): The amount of bottomland forest would increase by a total of 99 acres between Zones 1 and 3. Reforestation will be one of the last features completed since other project features need to be completed prior to planting. The monitoring target for initial and long-term monitoring is 80% survivorship of planted trees. Additionally, a target of increasing basal growth rate (positive growth rate) of marked trees will be used as an indicator of forest health.

Action Criteria (Adaptive Management Trigger): Full realization of desired outcomes is highly dependent upon flood events, deer browsing, and possible seedling competition with reed canary grass or other invasive species in the project area after construction. If the initial monitoring target of 80% survivability is not met then USACE and the project sponsor will re-evaluate the necessity to replant these trees. Adaptive management actions that could be taken to reduce deer browsing or competition may include, but not limited to, fencing, herbicide application, or mowing.

EVALUATION AND REPORTING

In general, monitoring is documented in Project Evaluation Reports (PER) that are scheduled at 5 year and 10 year post-project completion. The 5 year PER serves as a progress report. It is used to evaluate project success and inform of any changes that may be necessary to ensure the project is successful. The PER at 10 years closes out the monitoring of the project. The PER is drafted by the District with input from the project sponsor and state partners. IDNR will submit reports of data collection at years 1 and 5-10 to the MVS LTRM manager for use in development of the PERs. Once finalized, the PERs will be made publically available on the District's HREP homepage.

² Henderson, D., P. Botch, J. Cussimano, D. Ryan, J. Kabrick, and D. Dey. 2009. *Growth and Mortality of Pin Oak and Pecan Reforestation in a Constructed Wetland: Analysis with Management Implications*. Missouri Department of Conservation Technical Report Series: 2009. Missouri Department of Conservation, Jefferson City, MO.